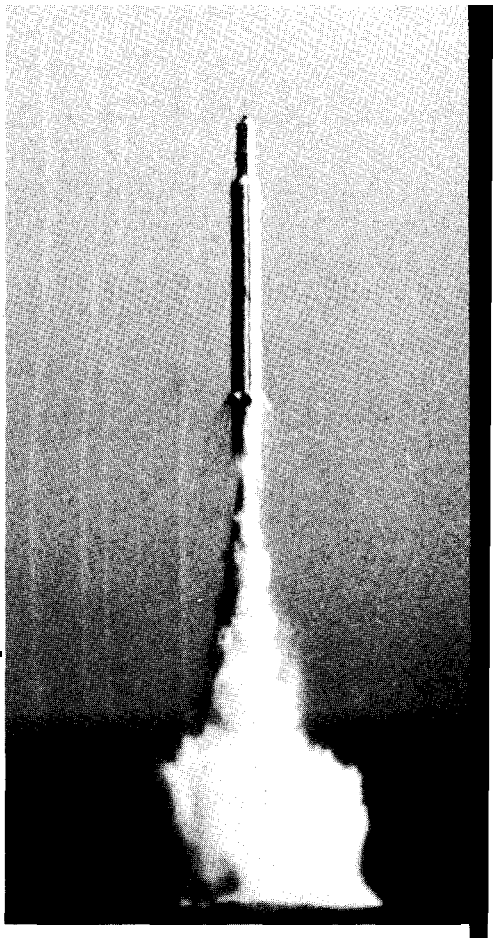
ROCKET POWER

New Directions



A 40-foot Hydra vehicle is blasted out of the sea, demonstrating that a firing system can withstand a marine environment and that a water-launched rocket can be stabilized in the open sea.

Bob Truax did not share in the belated success of *Vanguard I.* He had not agreed, in 1954, with the original configuration of the vehicle, namely, the combination of the *Viking* and *Aerobee* rockets and the addition of a solid third stage. "In the long run," he says, "practically everything was changed. The first stage engine was changed from the RMI to a General Electric. This required a change of propellants from lox and alcohol to lox and gasoline. The *Aerobee* was then found to be too small and had to be increased in size. As time went on, it became a program of changes. My only connection with the ultimate *Vanguard* was the second stage, which used the same general class of propellants as the old JATO units."

Truax had championed the United States experimental, scientific satellite program loud and clear. Once the cause had been picked up (largely because the Central Intelligence Agency had become aware of Russian progress in development of a satellite program), he had moved on to other fields. For example, when he received the Legion of Merit (in 1958, at the time of *Vanguard),* he was cited, somewhat belatedly, for his services in pioneering and advancing the Navy's efforts in the field of guided missiles and rockets. But, in addition, he was further cited for his "performance of duty while assigned to the Bureau of Aeronautics from June 11, 1953, to June 21, 1955." During that time, Commander Truax independently made a study titled "A Means for Making the Guided Missile Submarine a Primary Naval Weapon."

Truax's study had contained most of the elements of the U.S. Navy's current fleet ballistic missile program — an interesting subject to be examined later in this treatment.

When, after two years of badgering by Truax, BuAer gave an apparently final "no" to his proposition for a submarine-launched ballistic missile, the impatient Commander offered his services to Trevor Gardner, the Air Force assistant secretary who was building up a ballistic missile team under General Schriever in Inglewood, California. Truax was received enthusiastically by the now famous Western Development Division and was immediately placed in charge of creating a new missile — subsequently known as the *Thor* IRBM.

Once this program was underway, Truax began to hear rumors that the Air Force space program, an outgrowth of the old RAND study, was going to be transferred to General Schriever's WDD. Though the study was still in the paper stage, Gen. Schriever had ruled that if the project was ever to use any of his ICBM hardware, he was going to control the program.

Truax became Deputy Director, Weapons System 117L — the Advanced Reconnaissance System. This became the *Discoverer, Midas, Samos* program. "For a long time," says Truax, "it was the entire Air Force space program."

The concept of the satellite surveillance system had its origins in the 1946 RAND report. In the intervening years, it had barely escaped the obliteration suffered by many other programs. General Schriever had it transferred to the Ballistic Missile Division and, as Project 1115, it began to grow. As is now we11 known, it was a reconnaissance system –from space. *Samos,* for instance, was capable of taking pictures from a 300-mile orbit.

Truax originally had been loaned to the Air Force for a period of two

years. At the Air Force's request, this loan was extended an additional year. After that, since a transfer of some kind was apparently unavoidable, Gen. Schreiver arranged to have Truax (now a Captain) assigned to the newly formed Advanced Research Projects Agency, with the hearty concurrence of the latter.

In May 1958, he reported to ARPA as the project officer on the Advanced Reconnaissance System. Then, as his retirement approached, he returned to his old home, the Bureau of Aeronautics, for his final months on active duty. His boss there was Captain Thomas F. Connolly, who was heading up the Pacific Missile Range. "After I arrived back at the Bureau," Truax recalls, "Capt. Connolly said, 'Bob, I know you are about to retire, but before you go, I'd like you to do something more for us. I'd like you to do a paper on the Pacific Missile Range and what you think we should do with it; and I'd like you to do a study on the Navy in Space — what its potential is — and what you think the Navy's policy should be.'

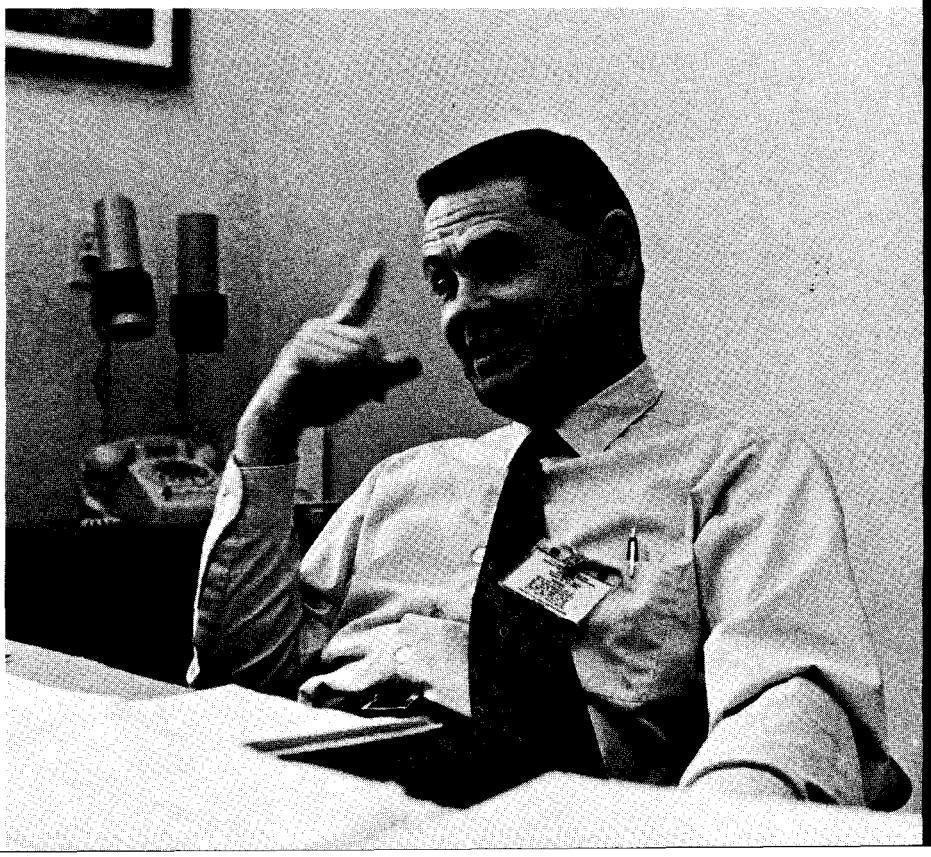
"Well, he liked my report so well he had it duplicated. I think every admiral in the Navy got a copy."

On the basis of Captain Truax's report, the Connolly Committee on the Navy's use of space and the science of astronautics was formed in April 1959. The resultant classified study established the Navy's future directions and its role in the Space Age.

Bob Truax retired from active duty in June 1959, after a remarkable career of rocket pioneering, testing, development, and farsighted planning. Today, as he applies the same talents, and same singleness of purpose, to another infant field — research and development of Surface Effect Ships — some of the ideas he proposed over a decade ago are still being "discovered."

A few days ago, he called us and said, "Hey, you know that old study on the externally stowed missile that I let you borrow? Well, they're kicking the idea around up there and I want to let them read my paper." We got the file over to his little white building within the hour.

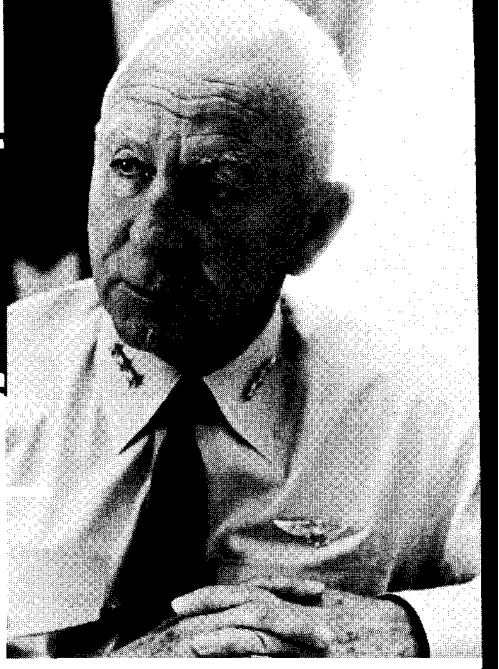
Robert C. Truax will always be a Rocketeer.



JOC JAMES JOHNSTON

The Navy's

THE BOSS OF NAVAL AVIATION



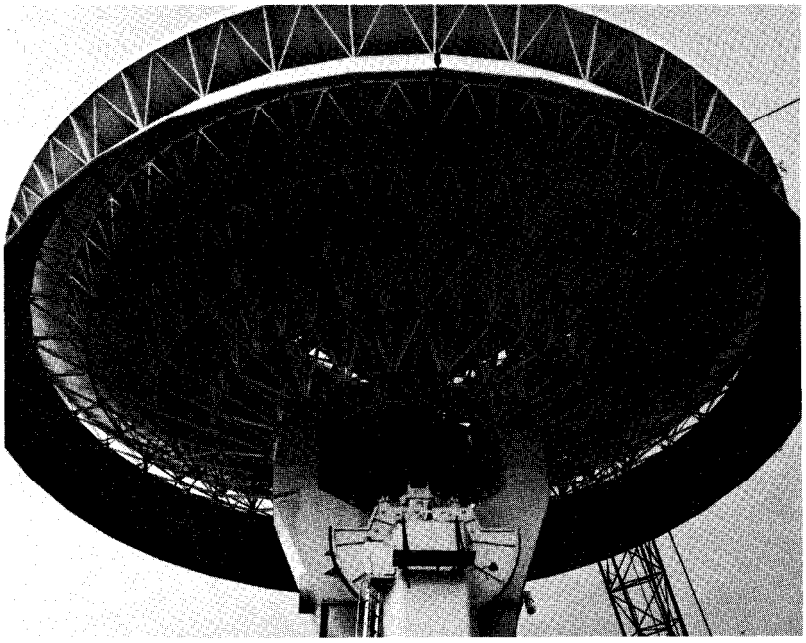
VICE ADMIRAL THOMAS F. CONNOLLY

Vice Admiral Thomas F. Connolly frowned. He had glanced out a window of his fourth floor Pentagon office and had noted the Washington smog drifting by. His gaze shifted to the spotless white model of the lunar module on his desk; then his eyes moved over to a similar, impeccable model of an aircraft. The miniatures seemed almost to glow against the polished wood surface. His expression mellowed.

On the wall behind his chair was a large R. G. Smith oil painting, one of the finest pictures of an aircraft carrier ever done. In it, the USS *Enterprise* looms out of a murky, morning haze on the South China Sea; a group of Navy fighters is flashing by the nuclear carrier, down low. Towering clouds rise above, dominating the scene. Toward the top of the picture, the air begins to clear and a view of blue space beyond can be observed.

It is an appropriate setting for the Deputy Chief of Naval Operations (Air) — the boss of U.S. Naval Aviation. But, at the moment, Admiral Connolly was thinking back to that time in the late Fifties when things began to *move* in space. "Missilery — ballistic missilery — had come on with a very great rush. The United States realized that the Soviets were building enormous rockets and would soon have an intercontinental capability. So," said Admiral Connolly, "we moved out very sharply in that period.

"I had just come into the Bureau from command of a carrier and found that an effort was being made to find a flag officer to take charge of the Pacific Missile Range, which, together with the Atlantic Missile Range and the White Sands Missile Range constituted the national ranges for ballistic missile firing and testing. For some reason, they just couldn't find an admiral for the job; so, although I was only a captain, I *was* an aeronautical engineer with missile experience, and I ended up with the assignment. It was decided to make me an assistant chief of BuAer — for Pacific Missile Range affairs.



The 60-foot directional antenna atop Laguna Peak at the Navy Astronautics Group Headquarters, Point Mugu, Calif., is landmark for motorists on Pacific Coast Highway.

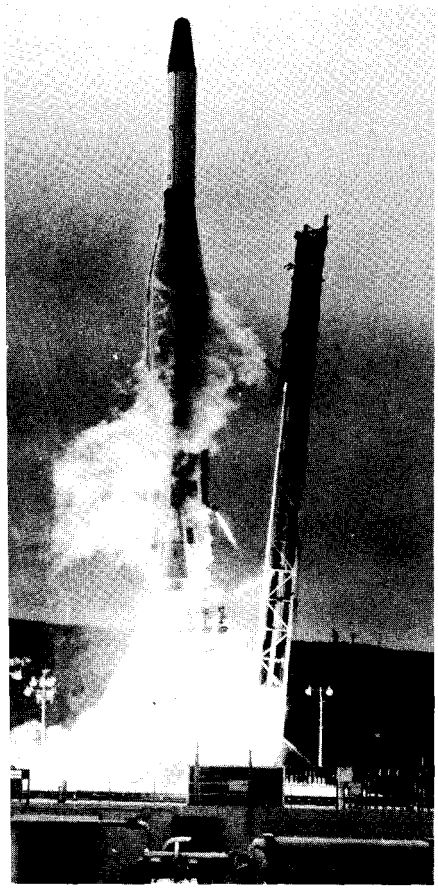
"In a very short time I could see that if the needs of the Navy were to be met, the job would have to be 'for Pacific Missile Range *and Astronautics.*' There was no good agency within the Navy capable of handling the possibilities of space with respect to *naval* military missions. So, we had to make that provision for 'astronautics.' For the next year or so I did what I could from the Washington end to help out Admiral Monroe and his people at the Pacific Missile Range (PMR). It grew into a fine operation."

The Naval Missile Center at Point Mugu, California, was the nucleus around which the Pacific Missile Range was developed. During WW II, it had become clear that if the nation's guided missile program was to pro-

Role in Space

REFLECTS ON THE ORIGINS OF THE NAVY PROGRAM

gress, the Navy would have to have a test range based on naval requirements. The result of this decision was the establishment of the Naval Air Missile Test Center in 1946. The original sea test range was only 75 by 150 nautical miles.



An Atlas/Burner II blasts off, carrying into space two Navy satellites: the Lidos for geodesy, and the ionospheric Orbis Cal.

As the national missile program gained momentum, the need for increased range capacity grew critical; "Mastery of Space" takes *space.* And money. Fifteen million dollars in construction were expended by 1961, and the range encompassed more than 10,000 miles. Major projects completed were MILS (missile impact location systems) buildings at Hawaii, Eniwetok, Midway and Wake Islands. New construction at Point Mugu included a hangar, sea-level climatic laboratory, instrumentation buildings, mess halls, BOQ's and storage facilities. One of the significant developments was the Life Sciences Department where experiments were conducted on animals and men in multiple stress environments and where "space journeys" were made by flight surgeons and Naval Aviators, with and without full pressure suits, in a ground-based "space ship," in order to study the effects of breathing pure oxygen at high altitude.

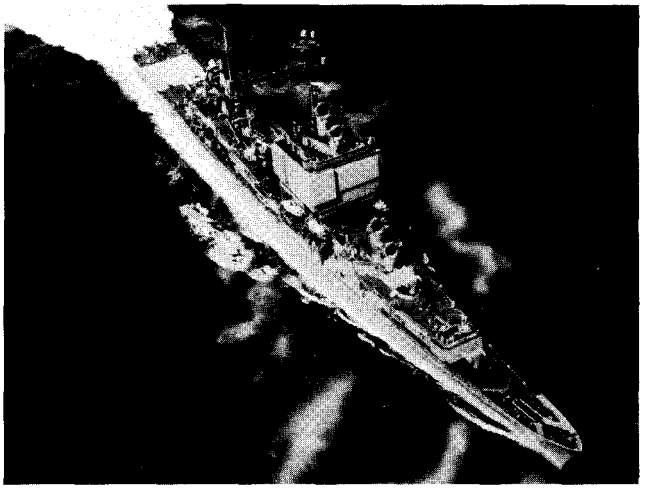
"We were tremendously spurred on by this new area of endeavor," the Admiral continued. "Although there was some criticism by a few agnostics and those who were constantly vying for the dollar, we received a great deal of support — from Admiral Burke, who was Chief of Naval Operations; Admiral Russell, the Vice Chief; and Admiral Pirie, DCNO (Air).

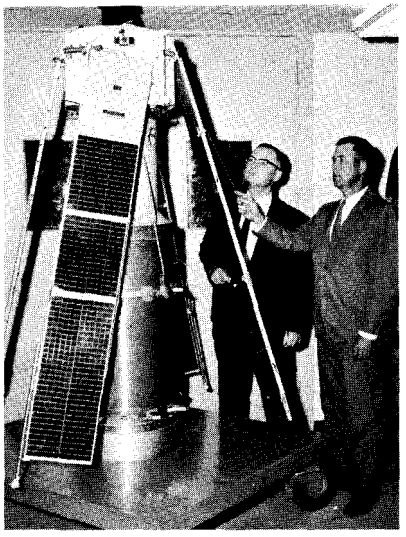
"Ten thousand people," Admiral Connolly said, "staffed the huge PMR complex which comprised five different ranges. It was a very fast moving and highly successful operation, not only capable of handling the ballistic missile firings of both the Air Force and the Navy, but also of doing the job with the shorter range weapons. With our excellent radar coverage, we could really do the shots that covered long distances and, at the same time, meet the national need. This evolved into Space: the Polar Orbit Range was developed for southward launchings from the Naval Weapons Facility at Point Arguello.

"As the size and range of the missiles increased, it became possible to build a *fractional orbiting* missile. That is what a ballistic missile really is. Well, with the Office of Naval Research and NRL being the first to get going with an earth satellite — the little *Vanguard* 'grapefruit' — we had learned a lesson. *Vanguard* went through a lot of growing pains and difficulties before it showed that it worked just as it was supposed to. Drawing on that experience, we asked the Johns Hopkins people to come up with a *navigational* satellite concept. It was aptly dubbed *Transit,* and was the first *real* attempt on the part of the Navy to make sure, from beginning to end, that an earth satellite would work for us. My office had the responsibility for its advancement. In all of this, we had the close cooperation of the Department of Defense, the Army, the Air Force and the then-young NASA."

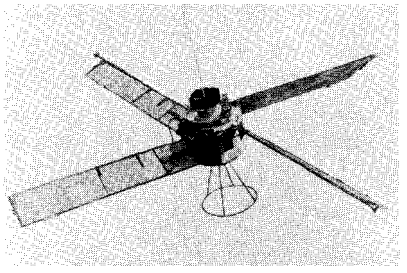
Admiral Connolly leaned forward. "But, where does the Navy *go* in space? Right then, we decided that we had better find out what was *solid* — what our legitimate prospects were for the future. I gathered up the best people I could get my hands on — Bob Truax, Win Berg, Bob Freitag, and a lot of others — and then, one by one, we called in every branch of scientific and industrial endeavor connected with space and had them lay out their programs. This constituted the so-called 'Connolly Committtee' and resulted in the study known as 'The Navy in the Space Age'."

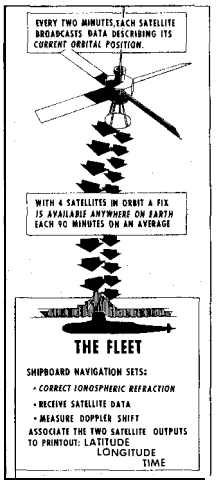
The Navy's Role in Space





The Navy Navigation Satellite, developed by Johns Hopkins University scientists is powered by solar cells and batteries. System was used in world cruise of USS Long Beach.





THE FINAL RECOMMENDATION OF THE COMMITTEE WAS: GET TO WORK!

The committee's report became the master plan for U.S. Navy space programs; Its chairman became a Rear Admiral, and Assistant to the Chief of the newly formed Bureau of Weapons, for PMR and Astronautics. The stated policy of the new organization was that the Navy would pursue research and technological developments necessary to enhance its ability to conduct operations in space which were in support of roles and missions assigned to the Navy. It would work in partnership with the other services and would vigorously support national civilian space programs.

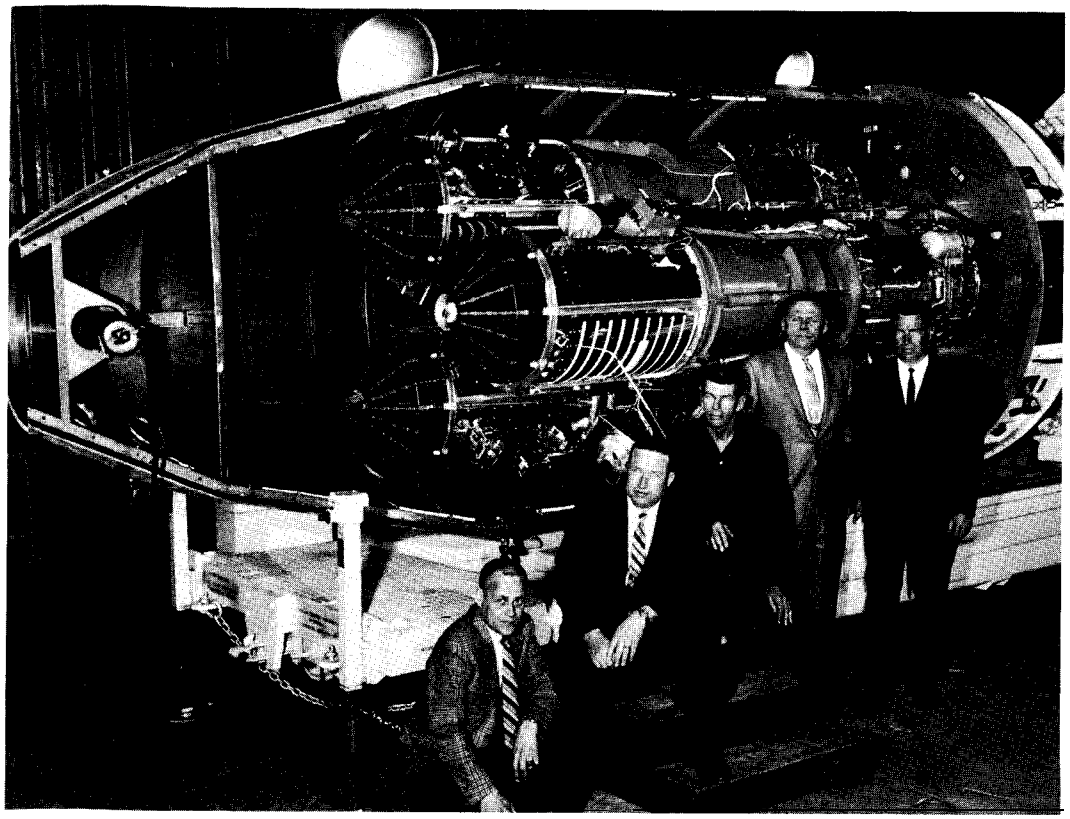
"Our basic objectives of ten years ago," said Admiral Connolly, "are essentially the same today, with a few refinements added. *Reliability* is a long, drawn out, painstaking matter that can't be solved by enthusiasm alone. The final recommendation of our committee had been to GET TO WORK! And that's what we have been doing over the years. Now we have that *reliability.*

"After we had determined just what was *solid* for the Navy, the lineup looked like this: Communications, Geodesy, Navigation, Weather Forecasting and Surveillance, but not necessarily in that order.

The NRL minitrack system of the *Vanguard* satellite program was pointed out by Admiral Connolly as the forerunner of the present Navy Space Surveillance System, commonly known as NavSpaSur. It may be recalled that minitrack was designed by Roger Easton to locate satellites which *transmitted* on a fixed frequency. But what about a *quiet Sputnik?* Needed was a detection system to locate and track *all* man-made objects in space.

A new plan was submitted to ARPA, approved, and by early 1959, NRL's NavSpaSur was operational. The system was similar to minitrack but used a high-powered, continuous wave transmitter to illuminate the satellite by radio. Reflected energy data from the target would then be obtained from various receiver sites and the object could be pinpointed. When the system became fully computerized, it took only seconds for analysis of a satellite detection to get to the headquarters of the Naval Weapons Laboratory at Dahlgren, Virginia, and thence to the North American Air Defense Command (NORAD) for further consideration. By 1970, more than 5,000 orbiting objects have been observed by NavSpaSur.

"Navigation," said Admiral Connolly. "With a satellite, you have your own star. Only, instead of just putting out visible light as an ordinary star does — a light that cannot be seen through clouds — *our* star would put out radio signals that could be picked up at any time. And, since we could accurately fix the position of any satellite, at any time, a ship could use our star to get a very accurate fix on its own location as *Transit* orbited by.



The triple OV-1 was product of joint effort by Air Force, NRL, Navy Space System Activity, Convair, and other personnel. Among results was better understanding of HF radio propagation.

"We, and other people," the Admiral continued, "foresaw that space *communications* would be a great aid. NRL was, even then, bouncing signals off the moon. They were using the moon as a *reflection* device in order to send a message from here in Washington to our station in Hawaii. This, of course, led to the ComSat organization which is both federally and industrially financed. This is how we get live TV shows, instantly, all over the world.

"Geodesy. This meant the ability to locate things on the ground. Even in our modern day and age, there are still a great many places on the face of the earth that the charts show to be in such and such a spot, when they are actually many miles away. The world's maps had been put together by acceptance of surveys done by various entities. Soviet maps, Chinese maps, Indian, British, French and even going back to old Portuguese and Italian maps. All have inaccuracies. So, geodesy was a thing we could do with satellites.

"And, finally," the chairman of the Connolly Committee said as he glanced over at the window, "we had weather forecasting — the surveillance of the earth and the movement of its cloud formations."

THE OBJECTIVES OF TEN YEARS AGO ARE ESSENTIALLY THE SAME TODAY.

Vice Admiral Connolly reached over to pick up a paper which an aide had brought in. He examined it, signed it, and sat back, thoughtfully. "We found a lot of ancillary uses for our space program. For example, it wasn't contemplated in the beginning, but we found we could use the very accurate navigational positioning derived from *Transit* to put in the inertial guidance platforms of our aircraft. If you have precise knowledge of exactly where you are at the moment of launch from a carrier, you can do a very precise navigational job in getting to a target, all-weather.

"I think it has been absolutely fantastic to see what has come out of the *disciplines* of space. In order to have a successful vehicle that can go into space and take men to the moon and back, *quality* equipment had to be created. Equipment that no one had dreamed of before. If it hadn't been for that quality and the built-in redundancy of the systems, we never would have gotten our *Apollo 13* boys back home."

Admiral Connolly has been described by the Press in various ways, most often as "peppery." The description didn't fit as he got up and walked to the window. "I really think that the space program has brought the world together. In these terrible times, I think that the success of the manned space flight program, more than anything else, has kept alive a certain warm respect for, and trust of, the United States."

He gazed out the window at the milky sky. "It looks like it might clear up. But, you never can be sure. . . ."